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MUNICIPAL AND INDUSTRIAL WATER SUPPLY AND WATER QUALITY CONTROL STORAGE REQUIREMENTS. TOWN CREEK RESERVOIR, WALKER COUNTY, GEORGIA

Public Health Service
Atlanta, Georgia

June 1963

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MUNICIPAL AND INDUSTRIAL
WATER SUPPLY AND WATER QUALITY CONTROL STORAGE REQUIREMENTS

Town Creek Reservoir
Walker County, Georgia

Prepared for
U. S. Army
Corps of Engineers
Mobile District

Department of Health, Education, and Welfare
Public Health Service, Region IV
Water Supply and Pollution Control Program
Atlanta, Georgia

June 1963

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INTRODUCTION

AUTHORITY

In letters dated November 19, 1962, and January 22, 1963, the U. S. Army Engineer District in Mobile, Alabama, requested the Public Health Service, Region IV Office to conduct water supply and water quality control studies for the proposed Town Creek Reservoir Project. The project is located in Walker County near the Town of LaFayette, Georgia.

This study has been made in accordance with: (1) the Water Supply Act of 1958 (Public Law 85-500, Title III) and a Memorandum of Agreement between the Department of the Army and Department of Health, Education, and Welfare, dated November 4, 1958; and (2) the Federal Water Pollution Control Act (Public Law 84-660) as amended by Public Law 87-88.

PURPOSE AND SCOPE

The purpose of the study was to determine the need for and value of municipal and industrial water supply storage in the Town Creek Reservoir for the economic life of the project, which was taken as 50 years. Both storage for water quality streamflow regulation and municipal and industrial water supply to the year 2010 have been considered. Determinations were made of the total amount of storage required as well as the value of this stored water for its intended uses. Town Creek, a tributary of the Chattooga River, is located in Walker County, Georgia, which lies in the extreme northwest portion of the State.

ACKNOWLEDGEMENTS

Assistance from the following agencies is gratefully acknowledged: the U. S. Army Corps of Engineers (Mobile District); the U. S. Geological Survey, Ground and Surface Water Branches (Atlanta); the Georgia State Department of Public Health; the City of LaFayette Officials; the LaFayette Planning Commission; various Walker County industries and firms; and other Federal, State, county, and local agencies.

SUMMARY AND CONCLUSIONS

SUMMARY

1. Town Creek Reservoir is tentatively to be located in the northeast corner of the municipal limits of LaFayette, Georgia, in Walker County. The reservoir will extend northeasterly toward the headwaters of Town Creek and is being studied for potential flood control, water supply, water quality control, and recreation uses.

2. Two study areas have been considered in this report: one for evaluation of water supply needs, and one for water quality control needs. The water supply study area extends from immediately south of LaFayette north to Chickamauga, Georgia. The water quality study area is a 10-mile stretch of Town Creek and the Chattooga River from LaFayette to the Duck Creek junction.

3. Major water users and waste producers in the study areas are the City of LaFayette and its associated commercial establishments and industries.

4. The City of LaFayette and a large textile mill are currently investigating alternate water supply sources because they are unable to obtain enough water from existing sources during critical periods.

5. The safe yield of present major sources of water supply is estimated to total 2.6 mgd. However, since only limited streamflow and spring yield data are available, this figure must be considered approximate. Present average municipal and industrial water demand is 2.8 mgd.

6. Primarily for reasons of economy, a single water supply source has been projected to meet 2010 needs. Since currently used sources are undependable at times, municipal officials in LaFayette have also expressed the desire to develop a single reliable source of water supply.

7. Untreated and insufficiently treated municipal and industrial waste effluents are currently polluting Town Creek and the Chattooga River over a 10-mile reach.

CONCLUSIONS

1. Population in the water supply section of the study area is anticipated to increase from 9,600 in 1960 to 15,600 persons in 2010.

2. By the year 2010, municipal and industrial water requirements are expected to increase to an average daily demand of 5.0 mgd.

3. Annual water supply benefits from the Town Creek project amount to $15,000.

4. With secondary treatment provided for both the municipal and industrial wastes discharged to Town Creek from the LaFayette area, there will be a need for storage for water quality control in the Town Creek project.

5. Release requirements for water quality control in Town Creek below LaFayette are given in Table 8 (p.35). Minimum annual water quality control benefits from the Town Creek project are $10,000.

DESCRIPTION OF PROJECT

LOCATION

The Town Creek watershed, a portion of the Coosa River tributary area, is located in the east central section of Walker County, Georgia (Figure 1). This area is typified by wide cultivated valleys of the Valley and Ridge province of northwestern Georgia. While the ridges in the vicinity attain elevations in excess of 2000 feet, the elevation of Town Creek at LaFayette is less than 800 feet. Total length of the watershed is approximately three miles at the proposed damsite. The drainage area at the damsite is 11 square miles.

While flowing generally southwesterly, Town Creek traverses the eastern half of LaFayette and joins a small tributary at the southern edge of town to form the Chattooga River. The proposed damsite is situated in the extreme northwestern corner of the LaFayette corporate limits - approximately one mile northeast of the downtown area.

STREAMFLOW CHARACTERISTICS

In the upper portion of the watershed, Town Creek falls at the rapid rate of 60 feet per mile. Within the LaFayette corporate limits, the fall is approximately 20 feet per mile with decreasing slope occurring below town. The channel of the stream is quite narrow in the upper reaches. It gradually widens to 15 to 20 feet before joining a spring-fed tributary immediately south of LaFayette to become the Chattooga River.

Figure 1

General map showing LaFayette and relation to pertinent landmarks in area, i.e., Chattooga, State of Georgia, etc.

Only limited information on stream discharge is available for Town Creek. Although some dry weather streamflows have been measured by the U. S. Geological Survey at the State Highway 143 Bridge crossing station in east LaFayette one mile below the proposed damsite, the data available are meager. The nearest recording stream gage is 20 miles below the damsite (Chattooga River at Summerville, Georgia). Available data indicate that the average flow per square mile in the LaFayette area during the period 1937 through 1955 was approximately one mgd (million gallons per day). Average flow at the damsite according to this information is calculated to be about 11 mgd. Much of the base flow of Town Creek is spring fed.

Cooperative streamflow investigations were made during the 1954 drought by the U. S. Geological Survey and the Georgia Department of Mines, Mining, and Geology. From the data obtained, estimates have been derived for 7-day minimum flows occurring once in 10 years. This estimated flow for Town Creek at State Highway 143 is 0.81 cfs (cubic feet per second) or 0.52 mgd - five percent of the average flow.

TABLE 1
ESTIMATED STREAMFLOW IN TOWN CREEK (mgd)

Location	Average (1937-1955)	7-day, 10 year minimum
Town Creek at State Highway 143	11	0.5

WATER QUALITY

The chemical and sanitary quality of Town Creek waters is discussed in detail in a later section. Above LaFayette the stream is of good quality, but below waste outfalls a rapid deterioration is evident for several miles downstream.

PROJECT DATA

Inasmuch as the Town Creek Reservoir Project is in the early investigation stage, firm figures for storage are not available. The impoundment is being planned primarily for flood control with provisions for meeting foreseeable water supply needs. It will also provide recreational opportunities.

STUDY AREA

LOCATION AND BOUNDARIES

The area of study has been divided into a water supply needs region and a water quality control needs area. Figure 2 (p.10) illustrates the boundaries of these areas. The water supply area selected for the year 2010 is that which the City of LaFayette serves at the present time. It incorporates most of the east central portion of Walker County. Increased water demand by the year 2010 will result from population and industrial growth within the water supply area limits.

At the present time, the LaFayette water supply system extends to the south and west only a mile beyond the corporate limits. It serves areas to the north, however, within one mile of Chickamauga, Georgia, and seven miles southwest of Ringgold, Georgia. This northern extension of the system closely follows U. S. Highway 27. Most of the system is within Walker County in northwest Georgia, but a small rural section of west central Catoosa County is also being served.

Precise limits were placed on water supply study area boundaries for three major purposes. Geographically the ridges east and west of LaFayette are physical limitations; jurisdictionally the municipal boundaries of Chickamauga and Ringgold tend to preclude further expansion to the north of a water system centered in LaFayette; and from an engineering standpoint it was felt that water supply sources for LaFayette are not capable of serving an area much larger than that served by the present system.

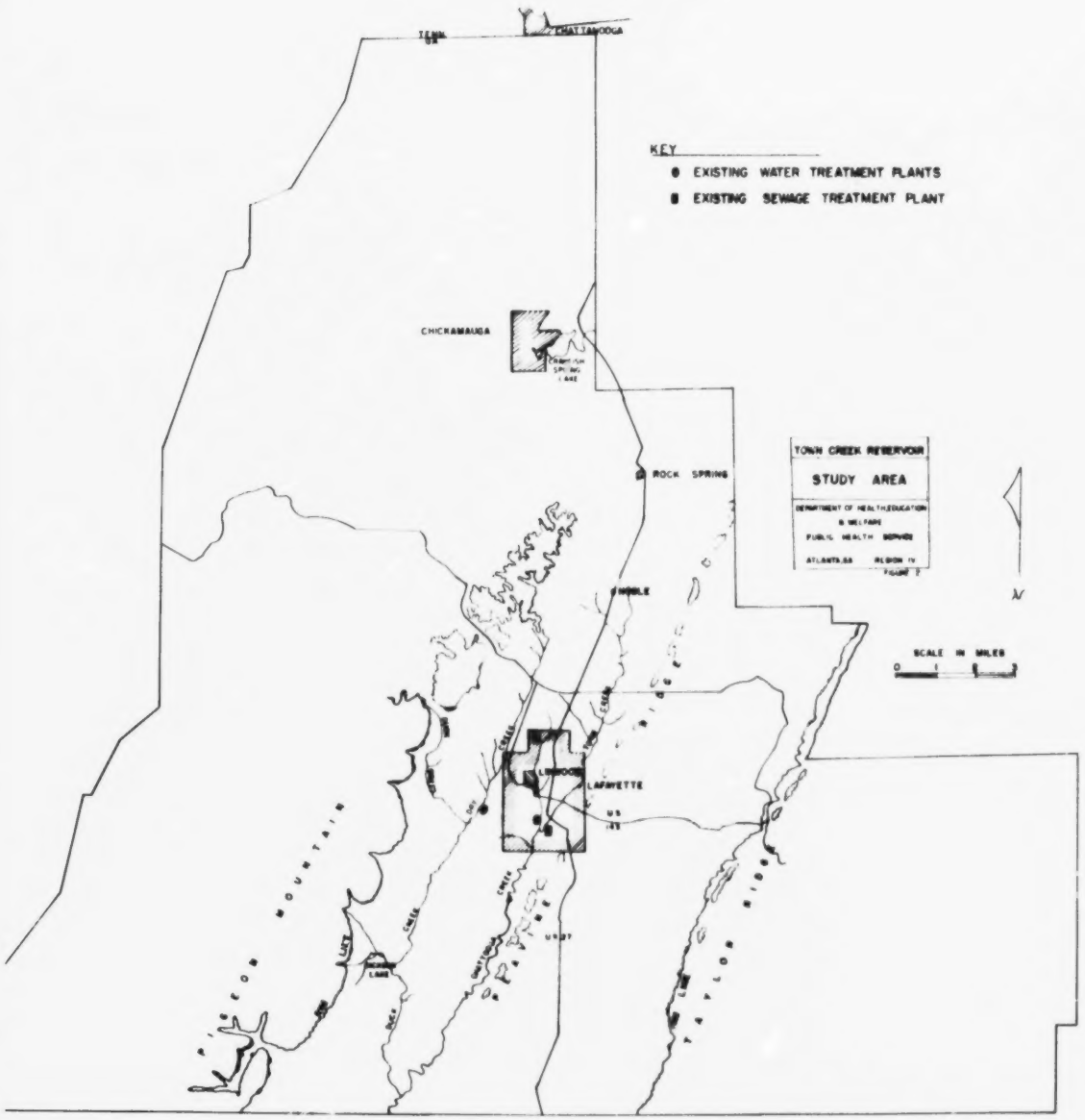


Figure 2

Study area boundaries.

The study area, in which the need for water quality control is determined, is the stream reach of Town Creek and the Chattooga River from LaFayette to the confluence of Duck Creek.

GEOGRAPHY

The study area is geographically situated in the valley bordered by the Pigeon Mountain Range on the west and Peavine Ridge on the east. Two major river basins are involved. From Noble, Georgia, southward, natural runoff flows into the Mobile River Basin and northward it flows into the Tennessee River system. Elevations at the northern limit are in the 750-foot range, rising to 920 feet near Noble, and descending again to 780 feet at LaFayette. Topography within the area ranges from rolling to flat on the Town Creek floodplain.

CLIMATE

Rainfall in the study area is extremely important from a water supply standpoint. This is due to the fact that the area is a headwaters region, and flow in streams and from springs is almost totally dependent on rainfall occurring within a relatively small section of northwest Georgia The average rainfall at LaFayette is 54 inches and average temperature is 61^{o}F.

PRINCIPAL COMMUNITIES AND INDUSTRIES

LaFayette and Linwood are the only incorporated communities within the study area. The Town of Linwood, a mill village, is completely surrounded by LaFayette. Other important communities in the study area are Noble and Rock Spring.

E. T. Barwick Carpet Mills, Inc., Ely & Walker Company, Inc. (sportsshirts), and the LaFayette Hosiery Mill, all of which are located in LaFayette, are the principal water-using industries.

THE ECONOMY

PRESENT

Walker County, in which LaFayette is located, is a part of the Chattanooga Standard Metropolitan Statistical Area. LaFayette, located in east central Walker County, is influenced by the City of Chattanooga in that it is a part of the Chattanooga trading area. However, it is sufficiently distant from Chattanooga so that it is not a suburb and has retained its individuality as a city.

The Town of Linwood lies within the city limits of LaFayette but has its own city government and as such is not a part of the City of LaFayette. However, because LaFayette supplies water to Linwood and because a large segment of the labor force in Linwood is employed in LaFayette, it was necessary to consider LaFayette and Linwood as a unit in the analysis of water supply needs and in the economic analysis of LaFayette.

The City of LaFayette including Linwood has grown from 1930 to 1960 at the same rate as Walker County, viz, 1 7/8 percent per year. The City of LaFayette itself, however, has grown at a faster rate - 2 5/16 percent per year. Populations of LaFayette, Linwood, and Walker County for specified years are shown in the following table.

TABLE 2
POPULATION OF LAFAYETTE, LINWOOD, AND WALKER COUNTY

Unit	1930	1940	1950	1960
LaFayette	2,811	3,509	4,884	5,588
Linwood	828	302	858	760
Total	3,639	3,811	5,742	6,348
Walker County	26,206	31,024	38,198	45,264

Source: U. S. Bureau of the Census

An analysis of employment data for the City of LaFayette as presented in the 1950 and 1960 U. S. Censuses, indicated that the data were not suitable for making projections for the city because the data are based on place of residence rather than place of employment. Therefore, it was necessary to use empirical data for projections. Employment by industry and by major categories of employment within the city and other pertinent economic information are contained in a report, Economic Indicators.[1/]

Study of the area economy was confined to the City of LaFayette and immediate surrounding area due to differences in economic development, population growth and industrial employment between LaFayette and Walker County.

1/ Report prepared by City Manager and Chairman, Planning Commission, City of LaFayette.

The principal economic activities of LaFayette are manufacturing, retail trade, and services. The countryside surrounding the city is devoted to agriculture and forestry, the principal products being dairy products, beef cattle, and pulpwood. Manufacturing in LaFayette consists largely of textile products and apparel, principally carpets and hosiery. There is also a small plant manufacturing concrete products.

In March 1963, 69 percent of total employment in LaFayette was in manufacturing. This is considerably higher than the percentage of total employment in manufacturing in Walker County or in Chattanooga as shown by the 1960 census which gives the percentage as 52 and 35 percent respectively. The 1960 census shows 49 percent of total employment in manufacturing in LaFayette.

Retail trade and services accounted for the next largest amount of employment in March, 1963. The survey also showed that 13 percent of the workers residing in LaFayette were commuting to other areas for work. These workers were employed in industrial plants in Trion, Summerville, Dalton, Chickamauga, and Chattanooga. The following table shows the estimated distribution of employment in LaFayette in March, 1963.

TABLE 3
ESTIMATED EMPLOYMENT BY MAJOR CATEGORIES - LAFAYETTE - MARCH, 1963[1/]

Category	Number Employed	Percent of Total Employment
Manufacturing	1800	69.2
Trade	155	6.0
Services	140	5.4
Construction	90	3.5
Other	40	1.5
Government	25	0.9
Transportation, Communications & Utilities	12	0.5
Finance, Insurance, Real Estate	8	0.3
Commuting to Other Areas	330	12.7
Total	2600	100.0

[1/] From Economic Indicators report.

Data from the U. S. Census indicate that from 1940 to 1960 the labor force in LaFayette grew at a greater rate than did the labor force in either Walker County or the City of Chattanooga. During this period the labor force of LaFayette grew at 2 1/2 percent annually as compared to 2.0 percent and 1 7/8 percent respectively for Walker County and Chattanooga.

The largest employers in the city are a carpet mill, a dry goods manufacturer, and a seamless hosiery mill. Collectively, these plants employ 1760 workers. Since 1960, three manufacturers, consisting of a manufacturer of extruded plastics, a woolen mill,

and a candy manufacturer, have turned down LaFayette as a possible industrial site because the city was not able to assure an uninterrupted water supply.[1/] From 1953 to 1963 the existing carpet mill has expanded from 100 to 1300 employees. During an interview with Public Health Service personnel, plant officials indicated their plans to expand still further if sufficient amounts of water were available. From 1950 to 1963 the apparel plant in the city expanded from four employees to 270. The hosiery mill has expanded from 50 to 190 employees during the period 1952 to 1963.

An indication of the economic growth of the LaFayette community may be obtained from the volume of bank clearings and postal receipts as given in the appendix.

FUTURE

Employment - Gains in future employment in the LaFayette community can be expected. Gains can be expected especially in the tufted carpets and rugs industry and in the hosiery industry. At the present time these two industries employ 60 percent of the total employed labor force in LaFayette.

There has been a rapid shift in consumer preference in women's and misses' hosiery. In 1954 seamless hosiery made up 16 percent of the total U. S. market and by 1960 it had risen to about 52 percent. This trend is expected to continue until seamless makes up all but a nominal percentage of the total market for women's and misses' hosiery.

1/ Economic Indicators.

The carpet and rug industry in LaFayette manufactures the tufted type. The industry manufactures automobile floor coverings as well as office and home floor coverings. In recent years one of the most outstanding developments in the carpet industry has been the increase in production of tufted carpets and rugs in competition with the woven types. It is estimated that the production of tufted carpets in the future will not increase at the rapid rate shown from 1954 to 1958, but instead will follow a somewhat slower growth pattern as a smaller share of the total carpet market remains to be taken from woven and knitted products.[1/] It is estimated that the value of shipments of tufted carpets and rugs in the United States will grow from a total of $255 million in 1958 to $416 million in 1975 (in 1959 dollars).[1/] Since there is a high correlation between employment and value added by manufacture in the textile industry in Georgia,[2/] employment can be safely projected from output projections for the industry.

In terms of percentage of total employment in LaFayette, only moderate increases are expected in construction; transportation, communications, and utilities; finance, insurance, and real estate; and government. Some increase is expected in trade, but the increase is not expected to be great because of the proximity of Chattanooga as a trading center. A considerable increase can be expected in services to supply needs of an increasing labor force. Manufacturing

1/ From reports by the U. S. Department of Commerce.

2/ See Appendix A.

can be expected to increase primarily because of growth industries, good transportation facilities, and large regional and national markets which have a large demand for the type of production performed in LaFayette. The following table shows the present and projected employment by major categories in LaFayette. Allowance has been made in the manufacturing employment projection for establishment of new low-water-using industries, although not specified as to kind or size.

TABLE 4
PRESENT AND PROJECTED EMPLOYMENT BY MAJOR CATEGORY - LAFAYETTE, GEORGIA

	1963		2010	
	No. of Employees	Percent of Total	No. of Employees	Percent of Total
Construction	90	3.5	150	3.8
Manufacturing	1800	69.2	2900	72.5
Transportation, Communication, and Utilities	12	0.5	25	0.6
Trade	155	6.0	300	7.5
Finance, Insurance, Real Estate	8	0.3	25	0.6
Services	140	5.4	450	11.3
Government	25	0.9	50	1.3
Other	40	1.5	100	2.4
Commuters	330	12.7	--	--
Total	2600	100.0	4000	100.0

Population - Population has been projected in two ways. It was first assumed that 40 percent of the population would be in the labor force and that unemployment would not exceed four percent. On the basis of employment, an employed labor force of 4,000 with unemployment at four percent would give a total labor force of 4170 and a total population of 10,400 in the year 2010.

Second, population was projected on the basis of a trend analysis, assuming that the rate of growth in the future would be essentially the same as that for the period 1940-1960. On this basis, population in the year 2010 would total 9,200. In the trend analysis an accelerated rate of growth was assumed after 1990 to reflect the growth of large metropolitan areas such as Chattanooga.

Anticipated population by the year 2010 has been selected as 10,400 as it appears that LaFayette will grow industrially at a more rapid rate in the future than it has in the past. Population projections for LaFayette reflecting both methods of projection are shown in Figure 3.

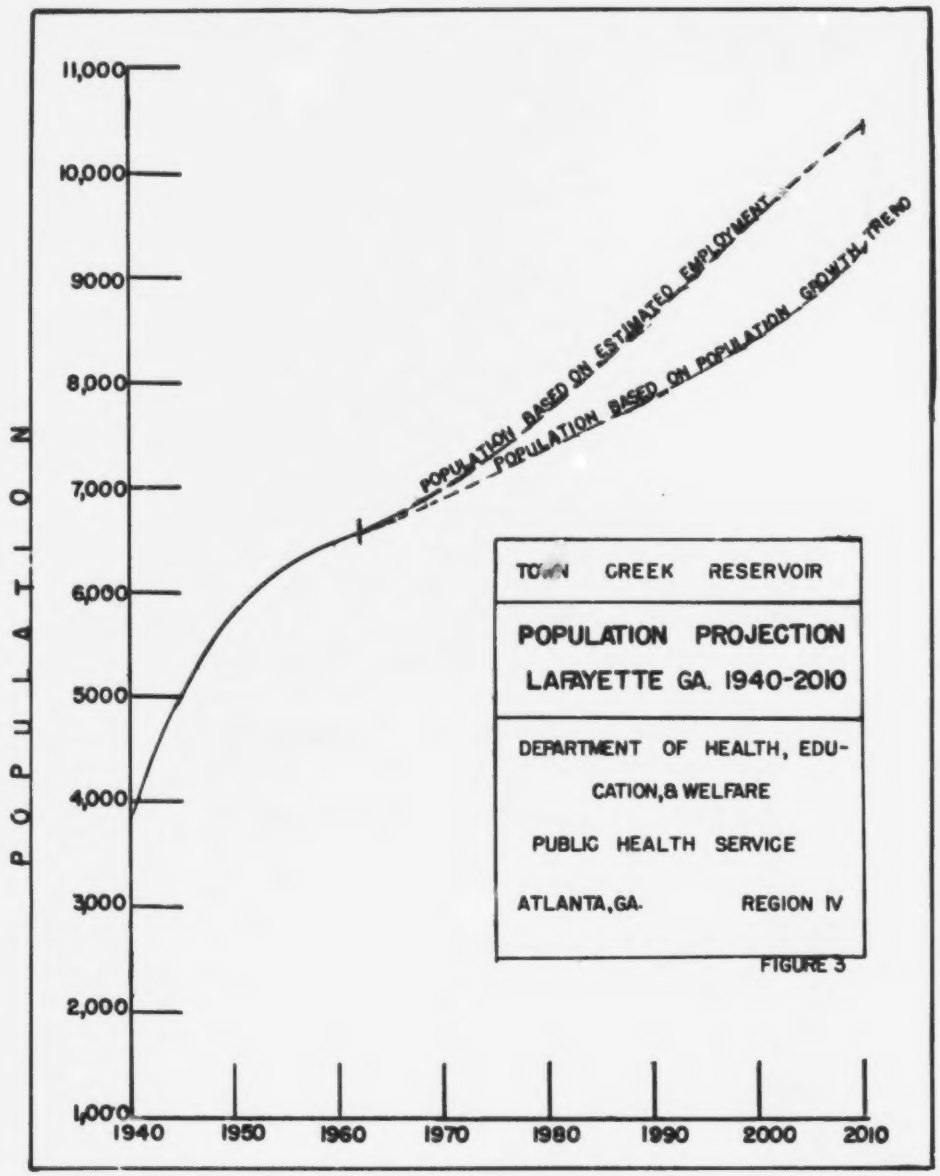

POPULATION
11,000
10,000
9000
8,000
7,000
6,000
5000
4,000
3,000
2,000
1,000
1940
1950
1960
1970
1980
1990
2000
2010
POPULATION BASED ON ESTIMATED EMPLOYMENT
POPULATION BASED ON POPULATION GROWTH TREND
TOWN CREEK RESERVOIR
POPULATION PROJECTION
LAFAYETTE GA. 1940-2010
DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
ATLANTA, GA. REGION IV

FIGURE 3

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

PRESENT WATER USES

Two major water supply systems exist within the study area - the City of LaFayette and Barwick Carpet Mills.

LaFayette System - Original settlement of LaFayette was centered around Big Spring which is located in the northwest corner of the present corporate limits. For some time the spring served as the chief source of municipal and industrial water supplies. Today, however, the flow from Big Spring alone is insufficient to meet supply demands in the area.

The area served by the present City water supply system has been described. Within this area are some 2,826 water connections, 70 percent of which are metered. Approximately 1,834 connections are located within the LaFayette city limits and 992 outside. (Linwood with a 1960 population of 760 is considered as part of the outside city limits area.) The average number of persons served per connection within the LaFayette city limits is approximately 3.5 and outside LaFayette it is 4.0. Total population served is calculated to be 9,600. Numerous industrial, trade, and commercial establishments are also served by LaFayette.

At the present time, LaFayette utilizes both spring and surface water sources. Figure 2 shows the location of the two sources. At Big Spring the city has constructed an open basin (Figure 4) around the upper springs area. Water collected in this basin flows 1/4 mile by gravity through a 10-inch main to a covered storage

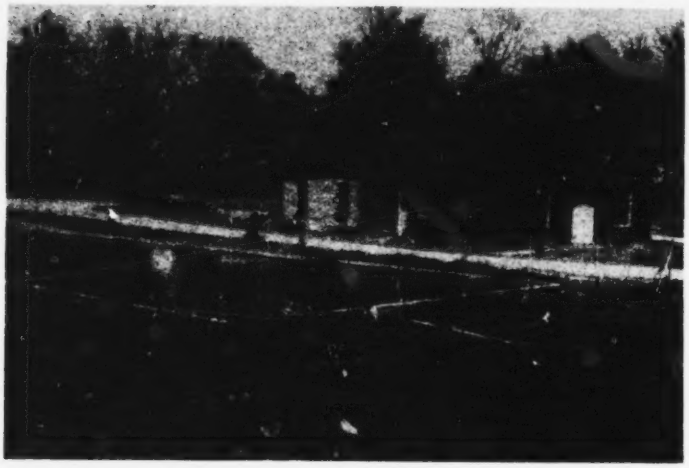


Figure 4
Open basin at Big Spring.

area near the pumping station. The pumping station reservoir receives water not only from the upper springs but from a spring at the station, and from a smaller spring immediately below the pumping station. Water at the lower spring is pumped with a 550 gpm rated pump into the covered storage basin. Prior to pumping into the distribution system, the spring water is chlorinated (gas chlorination) and the fluoride content is adjusted (sodium fluoride added) to optimum levels. High service pump capacity is 3.0 mgd (an emergency gasoline powered pump is also available).

The existing municipal surface water source is located on Duck Creek, west of the city limits. Duck Creek is formed by Dry Creek and a stream fed by Buzzard Roost Springs. A small low-head dam has been constructed at the junction (Figure 5), and raw water is pumped approximately one mile upstream to the treatment plant (Figure 6).

Figure 5
Low head dam on Duck Creek.

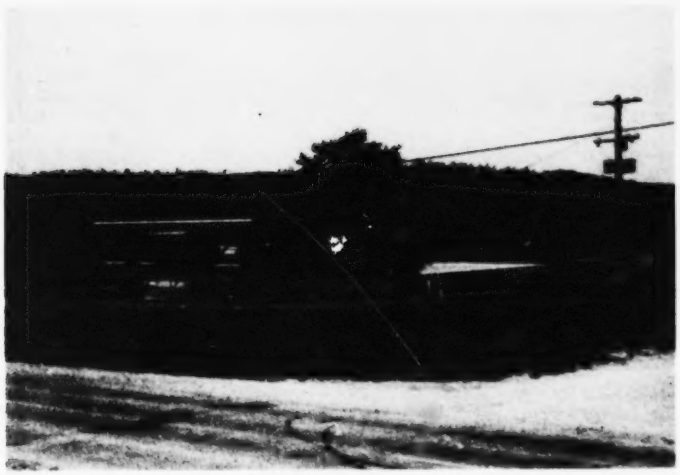


Figure 6
Duck Creek water treatment plant.

The plant is designed for 0.750 mgd average output, and provides coagulation, sedimentation, filtration, chlorination, and fluoride level adjustment. High service pump capacity is 1.6 mgd. Total above-ground storage in the entire LaFayette system is 1.65 million gallons (clear well storage is an additional 0.100 million gallons).

Water for the municipal system is ordinarily dependent upon flow from Big Spring. However, when the demand exceeds this supply during the peak demand, warm weather months or during emergencies, the plant at Duck Creek is used as a supplemental source. The present average daily water demand in the City of LaFayette system is approximately 1.0 mgd. During the summer maximum daily demands sometimes exceed 2.0 mgd, an amount which the city system is at times incapable of providing. The percentage of water from the LaFayette system which is used by industry varies from 19 to 40 but averages an estimated 20 percent or 0.2 mgd. Present per capita water use within the LaFayette water system area averages approximately 80 gpcd (gallons per capita per day) excluding service and manufacturing industry use. Based on the total 1.0 mgd output, however, this per capita water demand is estimated as 100 gpcd.

E. T. Barwick Mills, Incorporated System - Sanitary water for Barwick Mills in purchased from LaFayette. Process water, principally for vat dyeing operations, is normally obtained from two sources - Spring Creek and Town Creek (Figure 2). Water available from the first source is essentially overflow from the municipally-developed Big Spring area. This flow may be contained in its entirety through

diversion of Spring Creek (which flows directly beneath the main Barwick plant) to a holding reservoir. Additional water is pumped directly to the holding reservoir from Town Creek (Figure 7) at a point near the mill.

Inasmuch as available water from these two sources has proven to be inadequate during dry periods, Barwick has constructed a 400 acre-foot storage impoundment in the headwaters region of Town Creek, approximately four miles upstream from the water intake. When necessary, flow releases from the impoundment will be made to supplement natural streamflow at the industry intake. Total average process water use at present is 1.8 mgd.

Treatment provided for the process water consists of coagulation, sedimentation, filtration, zeolite softening, and chlorination. Some water is used in a recirculation system for cooling.

Rural Use - Rural water supply needs in the study area are supplied predominately from ground water sources and available information indicates that dependable yields are adequate for most needs. The total amount of rural water use is small, approximately 0.15 mgd.

Where rural water users have experienced difficulty in obtaining water from wells, the LaFayette water system has extended its distribution lines to the homes involved.

Summary of Water Uses - A summary of present water use in the study area is:

User	Estimated Average Daily Demand (mgd)
Manufacturing and Service Industries	2.0*
Urban population use	0.8
Rural population use	0.15
Total	2.95

*0.2 mgd furnished by LaFayette and remainder is Barwick system.

EXISTING WATER SOURCES

Quantity - Only limited data are available on safe yields from water supply sources used in the study area. Estimates made from these data indicate that Big Spring has a safe yield of 1.0 mgd, Duck Creek 1.0 mgd, and Town Creek 0.6 mgd. Total safe yield is estimated as 2.6 mgd; slightly less than the present average municipal and industrial water demand. Information on average flows was not available.

For the past few years, water available from presently used sources has not been adequate during maximum demand periods in the late summer and fall. The result has been curtailment of water use. Additional water supply sources need to be developed in order that study area growth will not be limited.

Quality - The water quality at Big Spring; Duck Creek; Buzzard Roost Spring, which is the principal source of base flow in Duck Creek; and Town Creek is illustrated in Table 5. Analyses shown were performed by various agencies on grab samples only, and they reflect quality conditions at the time of sampling.

The data indicate similar raw water quality at all locations listed. Hardness concentrations are considered in the medium range;

Figure 7
Barwick intake on Town Creek.

a range which is frequently accepted by domestic users without softening treatment. With the exception of one sample from Buzzard Springs in which iron content was reported as 0.4 ppm (parts per million), all physical and chemical values shown were within the limits of the Public Health Service Drinking Water Standards, 1962.

Available raw water data on bacteriological quality and on other parameters of sanitary significance are limited. A stream survey conducted in 1962 by the Georgia Department of Public Health indicated that the sanitary quality of Town Creek above waste outfalls was good.[1/] Only chlorination of Big Spring waters is needed to produce a bacteriological quality acceptable to the Georgia Department of Public Health.

1/ Telephone conversation with Georgia Department of Public Health.

TABLE 5
QUALITY OF WATER
(Chemical constituents in parts per million)

Location	Date	Temp. (°F)	Alkalinity as Ca CO_3	SiO_2	Iron	Mn	Ca	Mg	Total Hardness as Ca CO_3	Na	K	NO_3	HCO_3	CO_3	pH	SO_4	Cl	F	D.S.
Big Spring	4/20/38 1/	62	--	6.9	0.18	--	22	7.5	86	1.1	0.5	3.1	99	0	--	2.4	1.6	0.0	94
	4/20/59 1/	57	--	9.2	0.01	--	27	9.6	111	1.0	0.2	3.8	125	--	7.4	2.4	1.5	0.0	117
	4/17/63 3/	--	97	2.8	--	0.0	61 2/	46 2/	107	--	--	--	--	--	7.8	1.5	2	--	147
Duck Creek at intake	4/17/63 3/	--	95	5.8	--	0.0	77 2/	29 2/	106	--	--	--	--	--	8.1	2.5	2	--	146
Duck Creek	12/16/60	--	--	8	--	--	120 2/	26 2/	146	--	--	--	130	0	7.7	--	--	--	207
Buzzard Roost Spring	10/21/55 1/	72	--	6.0	0.4	--	40	14	157	Tr	Tr	0	158	Tr	8.0	5	7	0	236
	7/18/60 1/	60	--	8.6	0.09	--	41	9.6	146	1.4	0.7	2.9	168	--	7.5	2.4	1.5	0.1	167
Town Creek near radio tower	4/17/63 3/	--	89	5.6	--	0.0	72 2/	21 2/	93	--	--	--	--	--	7.9	3.0	2.0	--	143

1/ U. S. Geological Survey data.
2/ As Ca CO_3.
3/ Analyses performed by U. S. Public Health Service Laboratory in Jackson, Mississippi.

FUTURE MUNICIPAL AND INDUSTRIAL WATER NEEDS

In 1963 the LaFayette system served approximately 9,600 persons. By 2010 it is estimated that the system will expand within the study area to serve 15,600 persons - some 10,400 of which will reside in LaFayette and Linwood. Allowance has been made for a moderate expansion of the distribution network as well as for increased population within the present network. Population increase outside the LaFayette limits was projected using the same rate of growth as for the municipality.

Per capita water demand in the LaFayette system in 1963 (excluding industrial water use) was estimated as 80 gpcd. By 2010 the demand is expected to rise to 125 gpcd,[1/] and with a 2010 population of 15,600, the average daily municipal water use will be approximately 2.0 mgd.

A 62 percent increase in manufacturing employment is projected to occur between 1960 and 2010. Industrial water use is estimated to increase at approximately the same rate. Thus, the present 2.0 mgd industrial use is expected to rise to 3.0 mgd by 2010.

At the end of the fifty-year projection period, rural water users not connected to the study area system are expected to continue to obtain water from wells. The total amount of rural water used is also anticipated to be small.

Total average daily water use in the study area by 2010 is estimated to be 5.0 mgd. A breakdown of municipal and industrial water use is shown in the following table:

1/ This figure was based on past trends of per capita water consumption increases and on expected expansion of water-using service industries.

TABLE 6
AVERAGE DAILY MUNICIPAL AND INDUSTRIAL WATER USE

User	Present Use (mgd)	2010 Use (mgd)
Municipal	0.8	2.0
Industrial	2.0	3.0
Rural	0.15	minor
Total	2.95	5.0

PLAN FOR SUPPLYING FUTURE MUNICIPAL AND INDUSTRIAL REQUIREMENTS

Ultimate Capability of Present Sources - Estimates of the safe yield from present sources supplying the three major water users (LaFayette, Barwick Mills, rural areas) are listed in Table 7.

TABLE 7
ESTIMATED SAFE YIELD OF PRESENT WATER SUPPLY SOURCES

User	Estimated 1963 Average Demand (mgd)	Source	Estimated Safe Yield
LaFayette	1.0	Big Spring	1.0
		Duck Creek	1.0
Barwick Mills	1.8	Town Creek	0.6
		Big Spring	(see above)
Other (mostly rural)	0.15	wells	depends on location
Total			2.6

Inasmuch as the present raw water sources in the study area have proven to be inadequate in the last few years and are undependable at best, it is deemed desirable to develop an alternate source of water supply which would be adequate for future needs. The basic criterion for selection of an alternate supply was capability to supply a daily average flow of 5.0 mgd.

Alternative New Sources - Many alternate water supply sources in the study area were investigated. The search revealed that wells developed in the area were limited to small farm and domestic supply. Average yields of these wells were in the range of 60 gpm. Based on this figure it is estimated that more than fifty wells would be needed to supply 5.0 mgd. This would require an unnecessarily large expenditure of money.

Other water supply sources investigated included surface streams, springs, and other municipal systems. Two surface streams and two springs were studied in detail. In addition, the possibility of obtaining water from the City of Chattanooga, Tennessee was also considered.

WATER QUALITY CONTROL REQUIREMENTS

The use of water will almost inevitably result in the production of some liquid wastes which, even after a high degree of treatment, will degrade the quality of the receiving stream. It is essential that recognition be given to the need for flows which must be maintained in the receiving stream if the quality of these waters is to be kept at levels acceptable to State agencies. Based on a number of assumptions concerning stream assimilative capacity, waste effluent quality, and other environmental factors, estimates of streamflows needed to protect water quality have been made. (Sample computation in Appendix C).

PRESENT WASTE TREATMENT FACILITIES

Municipal sewerage facilities in the study area are provided only at LaFayette. The present facilities serve slightly more than 50 percent of the "within city limits" population - approximately 3,000 persons. In addition, a limited number of manufacturing and service industries are also served. The remainder of the population within LaFayette, including the municipality of Linwood, have septic tanks or privies for sewage disposal. Dwellings outside LaFayette also have individual waste disposal systems.

As shown in Figure 2, the municipal sewage treatment plant is located near the confluence of Spring Creek and Town Creek in the southeast section of town. Both primary and secondary treatment units had originally been provided at the plant, but the facilities are presently operated on a limited basis due to plant deterioration.

The estimated PE (BOD population equivalent) of wastes entering the plant is 3,800. After an approximate 20 percent treatment reduction, the effluent is discharged directly to Town Creek.

LaFayette is currently planning remodeling and expansion of their sewerage system and sewage treatment plant. The plant will eventually serve the entire municipality (excluding Barwick Mills). Federal funds have been offered to assist the city in its financing of the project.

Industrial wastes not discharged to the LaFayette sewerage system originate at E. T. Barwick Mills and the LaFayette Laundry and Dry Cleaning Company. The laundry anticipates connection to the city system in the near future, but is presently discharging untreated waste into Town Creek.

The E. T. Barwick Mills, Inc. plant discharged untreated waste, primarily from dyeing operations, into Spring Creek. Average daily waste flow is approximately 1.8 mgd with an estimated PE of 8800. Waste stabilization pond pilot plant studies have recently been completed by the company's consulting engineer. The investigations showed that 80 - 90 percent treatment efficiency might be effected by waste stabilization. Plans are underway to construct a full size pond in the near future.

When present plans are completed, insignificant amounts of wastes will enter study area streams from septic tank and agricultural land drainage.

STREAM QUALITY MAINTENANCE

As mentioned, estimates have been developed to indicate streamflows needed to maintain acceptable water quality in the Chattooga River below LaFayette. A minimum dissolved oxygen (DO) content of 4.0 ppm was assumed as a basic criterion for acceptable water quality. Studies showed that the critical stream stretch involved was from the juncture of Spring Creek and Town Creek to the confluence of the Chattooga River and Duck Creek approximately ten miles downstream. The most critical point within this stretch was computed to be immediately above the confluence with Duck Creek (additional flow from Duck Creek was found to be adequate to maintain acceptable water quality downstream from the Chattooga confluence, even during drought periods).

Streamflow requirements are expected to increase gradually during the 50-year study period due to population growth and industrial development. Table 8 indicates water release requirements from Town Creek Reservoir for 1963 and 2010, assuming that a minimum of 85 percent BOD (biochemical oxygen demand) removal has been provided for both municipal and industrial waste.

TABLE 8
TOWN CREEK RESERVOIR WATER RELEASE REQUIREMENTS (MGD)

Year	Dec.-Feb.	Mar.-April	May-June	July-Sept.	Oct.-Nov.
1963	0.1	0.1	0.5	2.1	0.1
2010	0.1	0.1	1.6	5.2	0.1

BENEFITS OF STORAGE

EVALUATION METHODS

Municipal and industrial water supply benefits result from improvements in quantity, dependability, quality and physical convenience of water use. The amount water users should be willing to pay for such improvements in lieu of foregoing them affords an appropriate measure of this value. In this study, however, as in general practice, the evaluation of this benefit was approximated by the cost of achieving the same results by the most likely alternative means that would be utilized in the absence of the project.

Water quality control benefits are the net contribution to public health, safety, economy, and effectiveness in use and enjoyment of water for all purposes which are subject to detriment or betterment by virtue of change in water quality. In this study, however, adequate means were not available to directly evaluate the economic effects of water quality improvement. Therefore, the cost of achieving the same results by the most likely alternative was used as a minimum approximation of this value.

Annual benefits are based on the annual equivalent capital cost of the least costly alternative and discounted back to present worth, plus annual cost of operation and maintenance (including replacement of maintenance equipment).

In the least alternate cost evaluation for water supply, consideration must be given to differential treatment costs. For this study it was determined that the quality from all alternate raw water sources was essentially equal and that no differential treatment cost need be evaluated.

Difference in transmission of water to a common point must also be determined. Here, alternates for the Town Creek project varied considerably. The present Duck Creek water treatment plant site was selected as the terminal transmission point.

Water quality control can be accomplished in several ways - additional treatment, regulated waste discharges, and streamflow regulation. Each of these alternates was considered in evaluating the monetary benefits for water quality control storage in the Town Creek Reservoir.

ALTERNATIVE WATER SUPPLY PLANS

A total of five alternate water sources were considered for the least alternate cost evaluation. These are listed below and their locations are shown in Figure 8: (1) Single purpose reservoir on Town Creek; (2) Single purpose reservoir on Duck Creek; (3) Development of Dickson Springs; (4) Development of Chickamauga Spring; and (5) Buying water from Chattanooga.

Town Creek - Impoundment for water supply on Town Creek was considered at the same site as the proposed multi-purpose project. Information received from the Mobile District, U. S. Army Corps of Engineers indicated that 4,420 acre-feet of storage would be needed to provide 5.0 mgd by the year 2010. Cost per acre-foot of storage

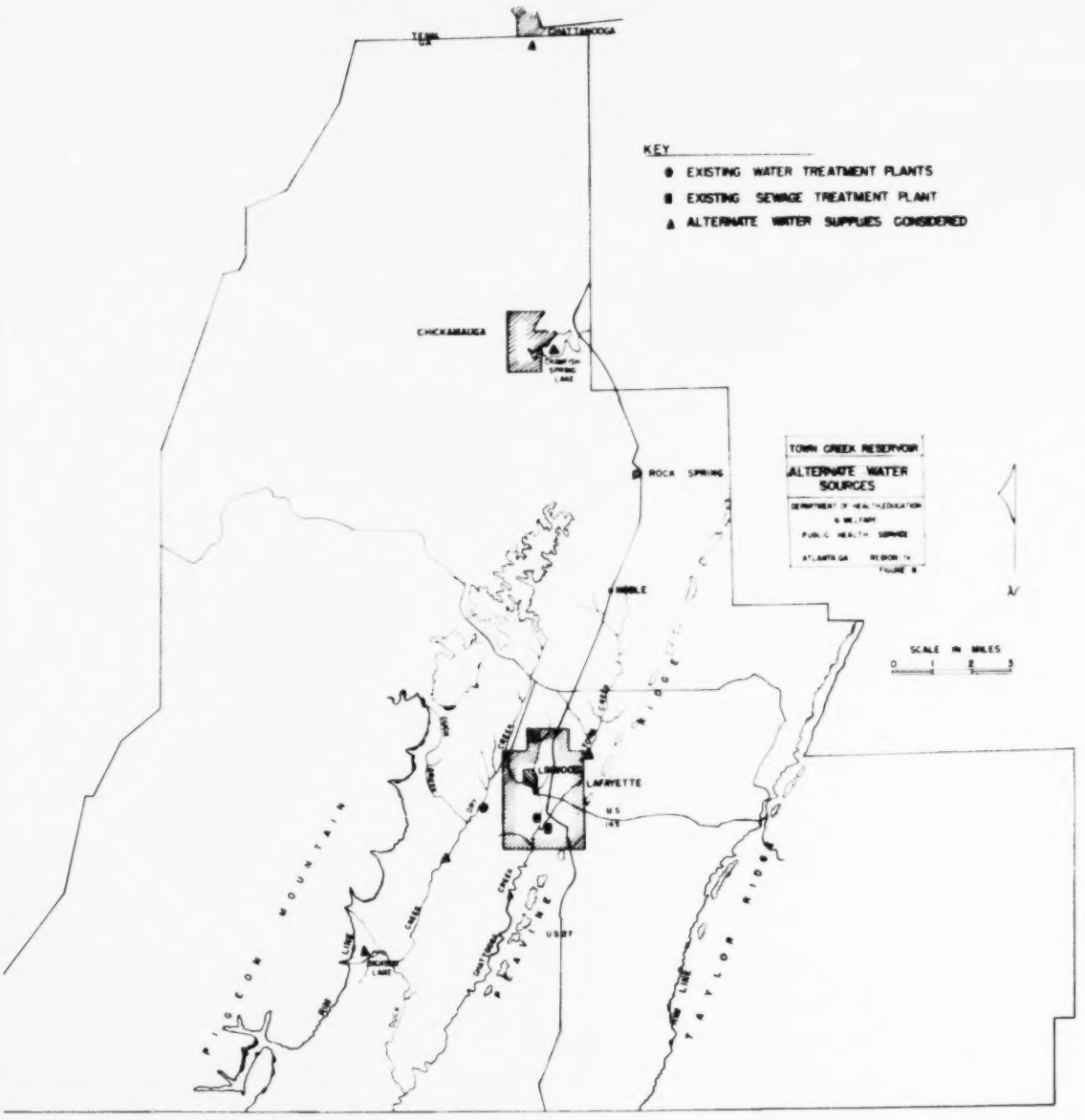


Figure 8

Study area map with overlay showing alternate water supply sources.

was obtained from Table 40 of the Senate Select Committee Print No. 32, Water Resources Activities in the United States, Water Supply and Demand. The cost per acre-foot for an impoundment in the 10,000 acre-foot size class was $160. Thus, total storage cost for the Town Creek site was estimated as $707,200.

As the Duck Creek alternate was closest to the water treatment plant (two miles) a differential transmission main installation cost for Town Creek was determined. The cost was $89,200 for an 18 inch cast iron main.

Duck Creek - Based on the same method for calculating storage cost used for the Town Creek impoundment, Duck Creek storage was estimated to cost $305,600 for 1910 acre-feet.

The Duck Creek site which is two miles downstream from the water treatment plant was the closest to terminal transmission point of all alternates considered. Thus, for purposes of selecting least alternate cost, the differential cost of laying main for Duck Creek did not have to be considered.

Dickson Springs - As Figure 8 shows, Dickson Springs is located approximately 4 1/2 miles southwest of LaFayette. An engineering study of the springs as an alternate water supply has been made for the city. However, information from U. S. Geological Survey reports indicated that flows much less than the 5.0 mgd required have occurred (1.44 mgd in 1949). Thus, no further consideration of Dickson Springs in the alternate cost evaluation was made.

Chickamauga Spring - Chickamauga Spring is one of the largest springs in northwest Georgia. It is located approximately 14 miles north of LaFayette, near the town of Chickamauga (which obtains water from the spring). Lowest recorded spring flow is 15 mgd - more than adequate to furnish study area and City of Chickamauga needs.

Water transmission main costs for this alternate were high, amounting to an estimated $824,200. Because this cost greatly exceeded both storage and transmission costs of the Town Creek and Duck Creek alternates, no further evaluation was made.

Chattanooga, Tennessee - The excessive transmission line cost for this alternate source (approximately $1,373,000) precluded further consideration in least cost evaluations. Chattanooga is approximately 22 highway miles north of LaFayette.

Summary - A summary of the various alternates considered is shown below:

TABLE 9
WATER SUPPLY ALTERNATES CONSIDERED

Alternate	Storage and/or Development Cost	Differential Transmission Main Cost	Reason for Selection or Non-selection
Single purpose reservoir on Town Creek	$707,200	$ 89,200	More costly than Duck Creek
Single purpose reservoir on Duck Creek	305,600	0	Least costly
Development of Dickson Springs	--	--	Not capable of furnishing 5.0 mgd at all times
Development of Chickamauga Springs	--	824,200	Eliminated on differential transmission cost
Buy water from Chattanooga	--	1,373,000	Eliminated on differential transmission cost

WATER SUPPLY BENEFITS

The total capital cost for developing storage on Duck Creek to furnish 5.0 mgd in the year 2010 would be $458,900. This investment may be broken down into the following categories:

Impoundment and intake -	$309,600
Pumps and housing -	9,300
Water transmission line -	139,000
Power transmission line -	1,000
Total	$458,900

Total annual benefit based on the Duck Creek alternate plan (@ 1/4 percent amortization for 50 years) is $29,000 which is categorized as follows:

Annual equivalent capital cost	$ 22,300
Annual replacement cost	239
Annual operation and maintenance cost	6,446
Total annual cost	$ 29,000

Benefit discounted to present value is $15,000.

Consideration of treatment and/or transmission costs was found not to be necessary. Operation and maintenance costs include: cost of 1 man-year for labor, maintenance equipment with replacement factor, and electric power.

ALTERNATIVE WATER QUALITY CONTROL PLANS

Both the City of LaFayette and the Barwick Mills plan to provide secondary treatment or its equivalent for the municipal and industrial wastes to be discharged to Town Creek. This will result in a reduction of 85 to 90 percent of the organic load to the stream (as measured by the BOD). Under present technology, this represents the most feasible degree of treatment which can be effected from both the technical and economical standpoint. Thus, a consideration of additional or "tertiary" treatment was not made.

Since supplemental (regulated) stream flows will be required for only four months of the year (August - November), a plan for regulation of waste discharges was considered. This would require storage of wastes during the low flow periods for discharge during the high flow periods. Several sites were considered for construction of holding ponds or impoundments but none were found which would provide the storage capacity required - 1500 acre-feet (4 mgd x 30 day/mo. x 4 mos. x 3.07 acre-feet/mg).

The only alternate left was that of storage on Town Creek for flow regulation. A single purpose reservoir at the project site to provide the supplemental flows required to maintain the releases for water quality control given in Table 8 was considered. Information received from the Mobile District indicated that 1910 acre-feet of storage would be needed to provide the supplemental flows required by the year 2010. Cost per acre-foot of storage was obtained from Table 40 of Senate Select Committee Print No. 32, Water Resources Activities in the United States, Water Supply and Demand. The cost per acre-foot for an impoundment in the 10,000 acre-foot class was $160. Thus, total storage cost for a single-purpose reservoir at the Town Creek site was $305,600.

WATER QUALITY CONTROL BENEFITS

The total capital cost for developing storage on Town Creek to provide supplemental flows required by the year 2010 would be $305,600. This would be for reservoir construction (including land costs).

Total annual benefit based on a single purpose reservoir on Town Creek (4 1/4 percent amortization for 50 years) is $19,200 which is categorized as follows:

Annual equivalent capital cost	$14,840
Annual replacement cost	370
Annual operation and maintenance cost	4,000
Total annual cost	$19,200

Benefits discounted to present value total $10,000. This is considered to be the minimum annual benefit from flow regulation.

At the present time, no municipal and industrial use is made of water in the study area stream stretch of Town Creek and the Chattooga River; however, the possibility exists that the stream will be used at some future date. Maintaining water quality in the stream at a minimum of 4.0 ppm dissolved oxygen will prevent the preclusion of future economic activity along the stream, loss or downgrading of recreational opportunities, impairment of health and welfare, damage to fish and wildlife, and degradation of the esthetics of unpolluted water in the stream.

If water quality were not maintained in the stream so that a future single economic activity such as industrial use were precluded because of degradation of water quality, annual loss to the community, the region, and the nation may far exceed the annual benefit of $10,000 resulting from flow regulation in the project. Such an economic loss would be in addition to the other damages enumerated above.

APPENDICES

APPENDIX A
Bank Clearings and Postal Receipts
LaFayette, Georgia
Month of December

Year	Bank Clearings[1/]
1940	$ 653,100
1945	1,199,100
1950	2,373,100
1955	3,785,600
1960	4,288,500
1962	5,815,700

Assuming the December buying is 50 percent bigger than any other month in the year, the annual bank clearings would be approximately $37,802,000.

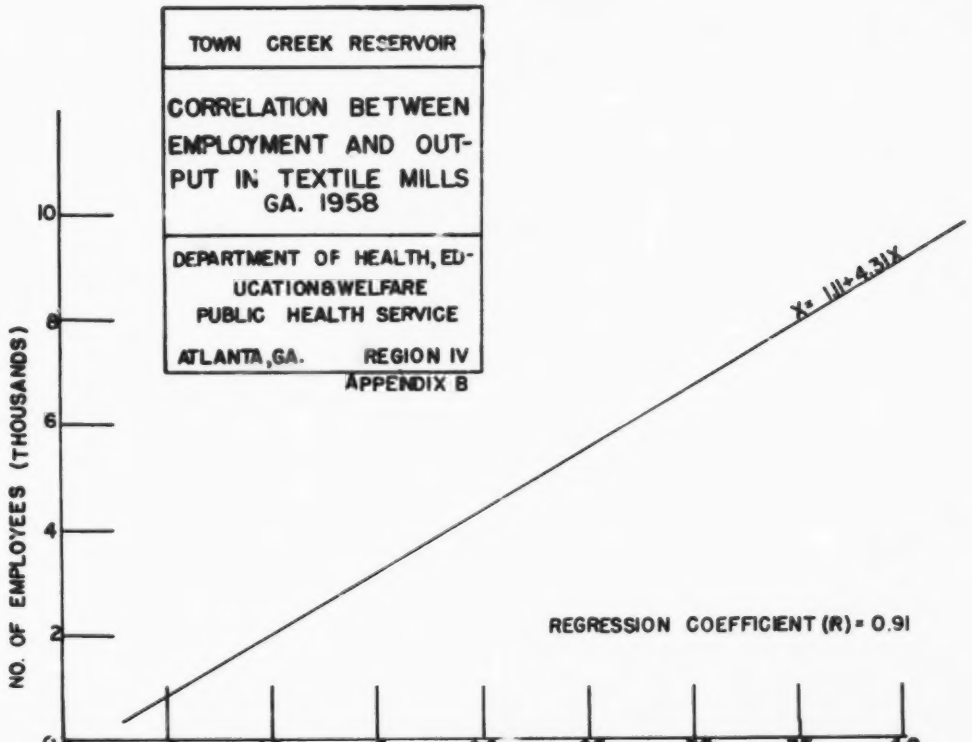
Postal receipts (excluding money orders and postal savings).

Year	Amount
1957	$ 45,800
1958	52,300
1959	60,200
1960	66,300
1961	70,300
1962	84,100
Gas Connections - City of LaFayette:	
1958	648
1962	1,184

1/ Economic Indicators.

Electric Meter Connections - City of LaFayette:

1956	1964
1962	2577


TOWN CREEK RESERVOIR
CORRELATION BETWEEN EMPLOYMENT AND OUTPUT IN TEXTILE MILLS GA. 1958
DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
ATLANTA, GA. REGION IV
APPENDIX B
X= 111+4.31Y
REGRESSION COEFFICIENT (R) = 0.91
NO. OF EMPLOYEES (THOUSANDS)
0
2
4
6
8
10
0
5
10
15
20
25
30
35
40
VALUE ADDED BY MANUFACTURE (MILLION DOLLARS)

APPENDIX C
Sample Computation for Determining Needed Dilution Flow in Town Creek in 2010

Find: Dilution flow needed in Town Creek to maintain 4.0 ppm dissolved oxygen (DO) during the period July through September. Waste load to stream after 85 percent BOD removal is estimated to be 1100 lb. (ultimate first stage) at an effluent flow of 4.0 mgd.

Assumptions:

(1) Water temperature - 25°C.

(2) Stream self-purification factor (f) - 2.0.

(3) Deoxygenation factor (k_1) - 0.15.

(4) Initial DO deficit in stream (Da_r) - 1.0 ppm.

(5) DO deficit of treated waste (Da_s) - 5.0 ppm.

(6) Average stream velocity - 0.9 ft/sec.

(7) Ultimate first stage BOD of Town Creek (La_r) - 4.0 ppm.

$$\text{Flow time} = \frac{\text{distance to Duck Creek}}{\text{velocity in mph}} = \frac{10 \text{ mi.}}{0.61 \text{ mph}}$$

$$= 16 \text{ hr or } 0.67 \text{ days}$$

$$\text{ultimate first stage BOD of sewage} = La_s = \frac{1100}{4\ (8.34)}$$

$$= 32 \text{ ppm}$$

$$\text{ultimate BOD of sewage stream mixture} = La_m = \frac{La_s\ Q_s + La_r\ Q_r}{Q_s + Q_r}$$

$$= \frac{32\ (4) + 4Q_r}{4 + Q_r}$$

DO deficit of sewage stream mixture = $Da_m = \frac{Da_s\ Q_s + Da_r\ Q}{Q_s + Q_r}$

$= \frac{5\ (4) + 1Q_r}{4 + Q_r}$

allowable DO deficit = D = Saturation DO - minimum DO

= 8.4 - 4.0

= 4.4 ppm

to compute dilution flow needed:

$$D = La\left(\frac{10^{-k_1 t}}{f-1} - \frac{10^{-fk_1 t}}{}\right) + Da\left(10^{-fk_1 t}\right)$$

$$4.4 = \frac{32(4) + 4Qr}{4 + Qr}\left[\frac{10^{-(0.15)(0.67)} - 10^{-2(0.15(0.67)}}{2 - 1}\right] + \frac{5(4) + 1Qr}{4 + Qr}\left[10^{-2(0.15)(0.67}\right]$$

$$4.4 = \frac{128 + 4Qr}{4 + Qr}\ (0.164) + \frac{20 + Qr}{4 + Qr}\ (0.63)$$

3.115 Qr = 16.0

Qr = 5.2 mgd

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